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IS 14582 (1998): Single-phase small a.c. electric motors for centrifugal pumps for agricultural applications [ETD 15: Rotating Machinery]

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Indian Standard

SINGLE PHASE SMALL a.c. ELECTRIC MOTORS FOR CENTRIFUGAL PUMPS FOR AGRICULTURAL APPLICATIONS — SPECIFICATION

ICS 29.160.30 ; 23.100.10

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

November 1998 **Price Group 3**

Rotating Machinery Sectional Committee, ET 15

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Rotating Machinery Sectional Committee had been approved by the Electrotechnical Division Council.

There are a number of centrifugal pump installations for agricultural application using single phase induction motors as the primemover. Though there is a separate Indian Standard specifying requirements for 3 phase induction motors for centrifugal pumps, a similar standard was not available in the case of single phase motors for centrifugal pumps. This Indian Standard is, therefore, prepared with a view to bringing about uniformity in various requirements such as torque, current, etc, and also to ensure interchangeability by specifying standard frame sizes. IS 7538 : 1996 'Three-phase squirrel cage induction motors for centrifugal pumps for agricultural application (*first revision*)' covers requirements for three-phase squirrel cage induction motors suitable for wider voltage variations.

Guidance for testing single-phase ac electric motors is given in IS 7572 : 1974 'Guide for testing single-phase a.c. and universal motors'.

To ensure satisfactory installation and maintenance of induction motors, it is urged that the recommendations contained in IS 900 : 1992 'Code of practice for installation and maintenance of induction motors (*second revision*)' should be carefully followed.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

AMENDMENT NO. 1 MAY 2002
TO
IS 14582 : 1998 SINGLE PHASE SMALL a.c. ELECTRIC MOTORS FOR CENTRIFUGAL PUMPS FOR AGRICULTURAL APPLICATIONS — SPECIFICATION

(*Page* 2, *clause* 13, *Note* 2, *last line*) — Substitute '3 to 6' *for* '4 to 7'.

(*Page* 3, *Table* 7, *col* 3, *line* 1) — Substitute 'η' *for* 'n'.

(*Page* 3, *Table* 7, *Note* 1) — Substitute 'η' *for* 'n'.

(*Page* 3, *Table* 7, *Note* 2) — Delete.

(ETD 15)

Reprography Unit, BIS, New Delhi, India

Indian Standard

SINGLE PHASE SMALL a.c. ELECTRIC MOTORS FOR CENTRIFUGAL PUMPS FOR AGRICULTURAL APPLICATIONS — SPECIFICATION

1 SCOPE

This standard covers 2 and 4-pole single-phase a.c. electric motors for centrifugal pumps for agricultural applications for voltage up to and including 250 V and having output up to and including 1 500 W.

1.1 The following types of motors are covered:

a) Capacitor start capacitor run,
b) Capacitor start and run, and
c) Capacitor start induction run.

1.2 This standard does not cover requirements of motors for submersible pumps.

2 REFERENCES

The standards listed in Annex A are necessary adjuncts to this standard.

3 TERMINOLOGY

For the purpose of this standard, definitions given in IS 1885 (Part 35) shall apply.

4 SITE CONDITIONS

4.1 Altitude and Temperature

Motors shall be designed for the following site conditions unless otherwise agreed between the manufacturer and the purchaser.

4.1.1 *Altitude*

Altitude not exceeding 1 000 m.

4.1.2 *Temperature*

The cooling medium temperature not exceeding 40°C.

4.2 Voltage and Frequency Variation

Motors shall be capable of delivering the rated output with:

a) the terminal voltage differing from the rated value by not more than +6 percent and −15 percent, or
b) the frequency differing from its rated value by not more than ±3 percent, or
c) any combination of (a) and (b).

In case of continuous operation at extreme voltage limits, the temperature-rise limits specified in Table 1 of IS 12802 shall not exceed by more than 10°C. Motors, when operated under the extreme conditions of voltage and frequency variation, may not necessarily have their performance in accordance with this standard.

4.3 It shall be assumed that the location and moisture or fumes shall not seriously interfere with the operation of the motor.

5 TYPES OF ENCLOSURES

The degree of protection to be provided by enclosures to the motor shall be IP 21, IP 22 or IP 23 (screen protected) or IP 44 or superior (totally enclosed) in accordance with IS 4691.

6 METHOD OF COOLING

The method of cooling shall be IC 01 or IC 41 in accordance with IS 6362.

7 MATERIALS

If desired by the purchaser, the materials and components used in the manufacture of motors shall conform to relevant Indian Standards, wherever they exist.

8 RATED CONDITIONS OF VOLTAGE, FREQUENCY, OUTPUT AND SPEED

8.1 Rated Voltage

The preferred rated voltage shall be 240 V in accordance with IS 12360.

8.1.1 Motors designed for operation at voltages other than 240 V shall be considered as complying with this standard provided they comply in all respects, except for values of maximum full load current which shall be changed in the inverse proportion to the voltage. The voltage for which the motor is designed shall be indicated on the name plate.

8.2 Rated Frequency

Preferred rated frequency shall be 50 Hz.

8.3 Rated Outputs

The preferred output ratings shall be 180, 250, 370, 550, 750, 1 100 and 1 500 watts.

8.4 Rated Speeds

Preferred rated speeds shall be those corresponding to two poles and four poles.

9 DIMENSIONS

9.1 For Coupled Motors

The dimensions shall correspond to the standard frame sizes specified in IS 1231.

NOTE — The outputs assigned to the frame sizes covered in IS 1231 may not be applicable.

10 DUTY AND RATING

For the purpose of this standard motors shall be continuously rated.

11 EARTHING

Earthing of the motor shall be done in accordance with the relevant provisions of IS 3043.

12 GENERAL CHARACTERISTICS

12.1 Breakaway (Starting) Torque

With rated voltage and frequency applied to terminals, the breakaway (starting) torque shall comply with the requirements given in Table 1.

Table 1 Torque of Single-Phase Motors
(*Clauses* 12.1 *and* 13.1)

Type of Motor (1)	Minimum Breakaway Torque as Percentage of Rated Torque (2)
Capacitor start capacitor run	150
Capacitor start and run	30
Capacitor start induction run	150

12.2 Overload

12.2.1 *Sustained Overload*

Motors rated in accordance with this standard are not capable of carrying sustained overloads.

12.2.2 *Momentary Excess Torque*

The motors shall be capable of withstanding on test the overloads in torque for 15 s given in Table 2 without stalling or abrupt change in speed (under gradual increase of torque), voltage and frequency being maintained at their rated values.

Table 2 Momentary Overload for Motors
(*Clause* 12.2.2)

Type of Motor (1)	Excess Torque as Percentage of Rated Torque (2)
Capacitor start capacitor run	60
Capacitor start and run	25
Capacitor start induction run	60

12.2.3 All the torque values shall be measured in accordance with IS 7572.

12.3 Temperature-Rise

Temperature-rise of motors for all types of enclosures, when tested under the rated conditions and in accordance with the requirements of this standard, shall not exceed the limits given in Table 1 of IS 12802.

12.3.1 *Measurement of Temperature-Rise*

The measurement of temperature-rise shall be done in accordance with **8.5** of IS 7572.

12.4 Temperature-Rise Test at Reduced Voltage

Temperature-rise test at reduced voltage shall be carried out in accordance with IS 7572 at a test voltage of 85 percent of rated voltage. The temperature-rise shall not exceed the specified temperature limits in Table 1 of IS 12802 by more than 10°C when the motor is continuously operating at 85 percent of rated voltage.

12.5 Insulation Resistance

Insulation resistance between all the windings combined and the motor frame shall be not less than 5 megohms at 500 V d.c. The test shall be made on hot motor soon after the temperature-rise test.

12.6 High Voltage

12.6.1 The high voltage test shall be made in accordance with **6** of IS 7572 except that the test voltage should be 1 500 V (rms).

13 PERFORMANCE VALUES

13.1 The values of minimum full load speed, maximum full load current, nominal efficiency for 4-pole and 2-pole a.c. motors at rated conditions of 240 V, 50 Hz shall be in accordance with Tables 3 to 6.

NOTES

1 For motors having rated voltage other than 240 V, values given in Tables 3 to 6 shall be applicable except for value of maximum full load current which shall be changed in the inverse proportion of the voltage.

2 In case the manufacturer declares superior values of performance characteristics than those specified in Tables 1 and 3 to 6, the declared values shall be subject to verification. The test values of the performance characteristics shall confoṙm to those declared by the manufacturer within the tolerances specified in Table 7 and shall, in no case, be inferior to the values specified in Tables 1 and 4 to 7.

Table 3 Values of Performance Characteristics of Capacitor Start Capacitor Run and Capacitor Start and Run 4 Pole Motors

(*Clause* 13.1)

Rated Output W	Minimum Full Load Speed rev/min	Maximum Full Load Current A	Nominal Efficiency, percent
(1)	(2)	(3)	(4)
180	1 275	2.1	54.0
250	1 300	2.8	56.0
370	1 325	3.9	58.5
550	1 350	5.3	62.0
750	1 350	6.6	66.0
1 100	1 375	9.1	69.0
1 500	1 375	12.2	70.0

Table 4 Values of Performance Characteristics of Capacitor Start Induction Run 4 Pole Motors

(*Clause* 13.1)

Rated Output W	Minimum Full Load Speed rev/min	Maximum Full Load Current A	Nominal Efficiency, percent
(1)	(2)	(3)	(4)
180	1 325	3.0	51.5
250	1 325	3.9	55.0
370	1 350	5.4	56.5
550	1 350	7.6	58.5
750	1 375	9.5	63.0
1 100	1 375	12.9	64.5
1 500	1 375	16.8	67.0

Table 5 Values of Performance Characteristics of Capacitor Start Capacitor Run and Capacitor Start and Run 2 Pole Motors

(*Clause* 13.1)

Rated Output W	Minimum Full Load Speed rev/min	Maximum Full Load Current A	Nominal Efficiency, percent
(1)	(2)	(3)	(4)
180	2 600	2.1	54.0
250	2 625	2.8	56.0
370	2 650	3.7	59.0
550	2 700	5.0	63.0
750	2 725	6.2	67.0
1 100	2 750	8.6	70.0
1 500	2 750	11.5	70.0

Table 6 Values of Performance Characteristics of Capacitor Start Induction Run 2 Pole Motors

(*Clause* 13.1)

Rated Output W	Minimum Full Load Speed rev/min	Maximum Full Load Current A	Nominal Efficiency, percent
(1)	(2)	(3)	(4)
180	2 650	2.9	51.5
250	2 675	3.7	55.0
370	2 700	5.1	57.5
550	2 725	7.3	59.0
750	2 750	9.0	63.5
1 100	2 775	12.5	66.0
1 500	2 775	16.3	68.0

13.2 Unless otherwise specified, tolerances on performance shall be in accordance with Table 7. Where a tolerance is stated in only one direction, the tolerance in the other direction is considered unimportant.

Table 7 Schedule of Tolerances

(*Clauses* 13.1 *and* 13.2)

Sl No.	Performance Parameter	Tolerance
(1)	(2)	(3)
i)	Efficiency	−15 percent of (100−*n*)
ii)	Power factor (cos Φ)	− 1/5(1−Cos Φ), *Min* − 0.02; *Max* − 0.12
iii)	Slip of motor at rated full load	+20 percent of rated slip at full load
iv)	Breakaway (starting) torque	−20 percent of the stated breakaway (starting) torque
v)	Breakaway starting current (locked rotor)	+20 percent of the stated breakaway starting current

NOTES

1 *n* = the efficiency expressed as percentage: and cos Φ = power factor.

2 Specific comments are invited regarding provision of negative tolerance on ship.

14 TERMINAL MARKING

Terminal markings shall be in accordance with IS 4728.

15 RATING PLATE

15.1 A rating plate stating the following shall be supplied with each motor:

a) Reference to this Indian Standard, that is, IS 14582;
b) Type of motor (*see* Annex B);
c) Name of the manufacturer;
d) Manufacturer's number and frame reference;
e) Type of duty rating;
f) Rated voltage in volts;
g) Frequency in Hz;
h) Rated output in watts;
j) Current in amperes at rated output;
k) Speed in revolutions per minute at rated output;
m) Class of insulation;
n) Value of capacitor and voltage rating of capacitor; and
p) Nominal efficiency.

15.2 BIS Certification Marking

The motor may also be marked with the Standard Mark.

15.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

16 TESTS

16.1 Tests specified shall normally be made at the manufacturer's premises.

NOTE — For the purpose of this standard, the tests to determine performance characteristics shall be made in accordance with methods specified in IS 7572.

16.1.1 The presence of user or his representative during the tests shall be agreed to between the manufacturer and the user.

16.2 Type Tests

The following shall constitute the type tests:

a) Measurement of stator resistance;
b) Test for no-load current, power input and speed at rated voltage and frequency;

   NOTE — Also capacitor voltage where applicable.

c) Test for breakaway (starting) torque at rated supply frequency (**12.1**);

   NOTE — This test may be conducted at reduced voltage and the torque at the rated voltage may be obtained by calculating as proportional to the square of voltage.

d) Locked rotor readings of voltage, current, power input and torque. This test may be made at reduced voltage;
e) Test for full-load performance at rated voltage and frequency (**13**);
f) Test for breakaway starting current at rated voltage and frequency;
g) Temperature-rise test (**12.3**);
h) Temperature-rise test at reduced voltage (**12.4**);

   NOTE — For the tests at (g) and (h), the pump may be used for loading the motor.

j) Momentary overload test (**12.2.2**);
k) Insulation resistance test (both before and after the high voltage test) (**12.5**); and
m) High voltage test (**12.6**).

16.3 Routine Tests

The following shall constitute the routine tests:

a) Insulation resistance test (before high voltage test only) (**12.5**);
b) High voltage test (**12.6**);
c) Test for no-load current, power input and speed at rated voltage and frequency;

   NOTE — Also capacitor voltage where applicable.

d) Locked rotor readings of voltage, current and power input at a suitable reduced voltage; and
e) Test for breakaway (starting) torque at rated supply frequency (**12.1**).

   NOTE — This test may be conducted at reduced voltage and the torque at the rated voltage may be obtained by calculating as proportional to the square of voltage.

16.4 Test Certificates

16.4.1 Unless otherwise specified when inviting tenders, the purchaser, if so desired by the manufacturer, shall accept manufacturer's certificate as evidence of the compliance of the motor with the requirements of this standard together with a type test (*see* **16.2**) certificate on a motor identical in essential details with the one purchased, together with routine test certificate on each individual motor for a batch of 20 or more similar motors is supplied on one order, type tests, as specified, shall be made on one of these motors, in addition to the other certificates if the purchaser so requires.

16.4.2 Certificates of routine tests (*see* **16.3**) shall show that the motor purchased has been run and has been found to be electrically and mechanically sound and in working order in all particulars.

16.4.3 It is recommended that type test certificate may be made in the form given in Annex C.

16.4.4 Unless otherwise specified when inviting tenders, the user, if so desired by the manufacturer, shall accept as evidence of compliance of the motors with requirements of this standard, certificates of tests made on a motor identical in essential details with the one purchased and of routine tests on each individual motor.

16.4.5 Certificate of routine tests shall show that the motor purchased has been run and has been found to be electrically and mechanically sound and in working order in all particulars.

16.4.6 If user demands, then type tests as laid down in this standard shall be carried out on one motor in 250 provided the executive order quantity is 250 numbers or more, in one single lot.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
1231 : 1974	Dimensions of three-phase foot-mounted induction motors (*third revision*)
1271 : 1985	Thermal evaluation and classification of electrical insulation (*first revision*)
1885 (Part 35) : 1993	Electrotechnical vocabulary: Part 35 Rotating machinery
3043 : 1987	Code of practice for earthing (*first revision*)
4691 : 1985	Degrees of protection provided by enclosure for rotating electrical machinery (*first revision*)
4728 : 1975	Terminal marking and direction of rotation for rotating electrical machinery (*first revision*)
6362 : 1995	Designation of methods of cooling of rotating electrical machines
7572 : 1974	Guide for testing single-phase a.c. and universal motors
12360 : 1988	Voltage bands for electrical installations including preferred voltages and frequency
12802 : 1989	Temperature rise measurement of rotating electrical machines

ANNEX B

(*Clause* 15.1)

TYPES OF MOTORS

B-1 TYPES OF MOTORS

B-1.1 Capacitor Start Capacitor Run (Two Value Capacitor Motor)

These motors have higher starting torques and lower starting currents than split-phase motors and are suitable for frequent starting. They have a lower noise level, higher, efficiency and power factor than split-phase motors and capacitor start and induction run motors (*see* **B-1.3**).

B-1.2 Capacitor Start and Run (Permanent Split Capacitor Motor)

These motors have lesser starting torque and starting current than capacitor start capacitor run motors and are used where lower starting torques are acceptable. In the running condition their characteristics are similar to capacitor start capacitor run motors.

B-1.3 Capacitor Start Induction Run (Capacitor Start Motor)

These motors have higher starting torques and lower starting currents than split-phase motors.

NOTE — This is the least preferred type since the load current is higher and efficiency and power factor are lower than the other two types.

ANNEX C

(*Clause* 16.4.3)

FORM FOR TYPE TEST REPORT OF SINGLE-PHASE INDUCTION MOTOR

Name and address of manufacturer ....
As per IS 14582

Certificate No. ....
Order Acceptance No. ....

Purchaser ....
Purchaser's Order No. ....

NAME PLATE DATA

Enclosure	Output	W	Voltage V	50 Hz
Frame	Speed	rev/min	Current A	
Insulation	Rating		Start Capacitor........V... µF	
Class			Run Capacitor.........V....µF	

TEST CHARACTERISTICS

Loading Condition	Volts	Amperes	Watts	Percent Slip	Power Factor	Efficiency
No load test						
Full load test						

BREAKAWAY TORQUES AND STARTING (LOCKED ROTOR) CURRENT

Breakaway Torque (Locked Rotor) in kgm	Breakaway Starting (Locked Rotor) Current	Input Watts

TEMPERATURE — TEST RUN

Condition of Test				Temperature of Cooling Air °C	Temperature-Rise	
Hours Run	Voltage	Current	Watts		Winding R/T	Core

Insulation resistance test...megohm
High voltage test ....Volts for one minute
Resistance of windings..ohm at ....°C
(at room temperature)
Momentary overload for ....15 seconds ....Test OK

Tests conducted on Motor No. ....
Tested by ....

Approved by ....
Date.........................

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002
Telephones : 323 01 31, 323 33 75, 323 94 02

Telegrams : Manaksanstha
(Common to all offices)

Regional Offices :		Telephone
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110 002	323 76 17 323 38 41
Eastern	: 1/14 C. I.T. Scheme VII M, V. I. P. Road, Maniktola CALCUTTA 700 054	337 84 99, 337 85 61 337 86 26, 337 91 20
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